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On Books

Where Does Behavior Come From? A Review of Epstein's *Cognition, Creativity, and Behavior*

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Anyone who reads with pencil in hand will find good use for the instrument while reading Robert Epstein's anthology, *Cognition, Creativity, and Behavior* (1996). Much of the reader's scribbling is apt to be done in the chapters on what Epstein calls generativity theory.

Generativity theory attempts to answer the question: Where does behavior come from? It assumes, among other things, that all behavior is novel. There is nothing fundamentally new or controversial in this. The essential novelty of behavior, the fact that each act is in some way different from all previous acts, is widely recognized; it is, for example, what makes shaping possible. Yet for the most part, behaviorists have focused on what is common to a class of behaviors (lever presses that close a microswitch) and have ignored the novel aspects (every lever press is unique in some way). Epstein wants to know what accounts for what is *new* in behavior. Where, for example, do insightful solutions come from?

During World War I, Wolfgang Kohler, one of the founders of Gestalt psychology, performed experiments on animal problem solving that have become classics. In the suspended fruit problem, Kohler suspended a banana or other fruit high above the floor of a pen and placed a large box in another part of the pen. Chimpanzees presented with this problem attempted to reach the fruit by jumping, but soon gave up because the fruit was out of reach. Some animals found another solution, however. Kohler (1927/1973) writes that a chimp named Sultan "paced restlessly up and down, suddenly stood still in front of the box, seized it, tipped it hastily straight towards the objective, but began to climb upon it at a (horizontal) distance of half a metre, and springing upwards with all his force, tore down the banana" (p. 40). Another chimp, Koko, "seized [the box], dragged it in one movement up to a point almost directly beneath the objective . . . , mounted it, and tore down the fruit" (p. 42).

The significance of this experiment, and others like it, is that the problem was solved by the sudden appearance of a new behavior. There was no "trial-and-error" learning, such as Thorndike had described, and no gradual shaping of new responses from old ones, such as Skinner would later demonstrate. After a period of apparent confusion, the chimp retrieved the banana in "a perfectly continuous action" (Kohler, 1927/1973, p. 40). The solution appeared as a whole, not as a series of discrete responses, and it appeared in its entirety the first time, not as a series of approximations. "It seems," concluded Bertrand Russell (1927/1960), "that there are two ways of learning, one by experience, and the other by what Kohler calls 'insight' " (p. 42).

Epstein, R. (Ed.). (1996). *Cognition, creativity, and behavior: Selected essays*. Westport, CT: Praeger.

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(Kohler's translator notes that the German word *einsicht* is rendered as both *intelligence* and *insight*. The implication is that insightful learning requires intelligence, whereas learning "by experience" does not.) Psychology textbooks from Kohler's day to this have suggested that operant learning is a simple form of learning, important mainly in understanding animal behavior, that results from environmental events, whereas insight is a more complex form of learning, vitally important in human behavior, that must be attributed to the workings of a mysterious and ultimately unknowable mind.

Russell saw more clearly than many behaviorists the importance of Kohler's discovery, and the problems it created for the behaviorist's view that behavior can be accounted for entirely in terms of physical events. "Until the behaviourists have satisfactorily explained the kind of discovery which appears in Kohler's observations," he wrote, "we cannot say that their thesis is proved" (Russell, 1927/1960, p. 45).

Behaviorists responded that organisms have different environmental histories, and these histories affect performance. Birch (1945), for example, demonstrated that insightful solutions to problems were a function of prior experience with the problem materials. (Kohler, 1927/1973, had, in fact, noticed the same thing; see his comments on the "door problem.") Luchins (1942) showed that prior experience could inhibit as well as facilitate the appearance of a new solution. And Harlow (1949) showed that in certain circumstances insight emerged gradually over many trials, not abruptly and as a whole. But to many people the behaviorists' replies seemed speculative and weak: Learning history *might* produce insightful behavior, but it had not been shown to do so.

Then Epstein, Kirshnit, Lanza, and Rubin (1984) published an article that essentially replicated Kohler's suspended fruit problem in pigeons. They put a pigeon in a chamber and suspended a tiny facsimile of a banana from the ceiling. They also put a box in another part of the chamber. The bird had previously received food when it pecked the banana, but had learned *not* to fly or jump toward it. Now the banana was out of reach. What would the bird do? At first it looked back and forth from box to banana, as though puzzled, just as Kohler's chimps had done seven decades earlier. Then the bird suddenly went to the box and began pushing it toward the banana. When it had gotten the box under the banana, it immediately hopped onto the box, reached toward the banana, and pecked it.

Anyone reading about this experiment would have to see the parallel to Kohler's suspended fruit problem, and would have to admit that if Kohler's chimp demonstrated insightful learning, then so had Epstein et al.'s (1984) pigeon. The difference is that whereas Kohler generally ignored prior learning history, Epstein et al. systematically manipulated it. What they found was that whether the insightful solution emerged depended on the bird's prior experience. Reaching a solution required that the bird had first learned (a) to push a box toward a goal (*not* the banana, but toward a green spot placed at random points in the chamber), and (b) to climb onto a box and peck a banana. Birds that had learned to climb on a box and peck, but not to push a box toward a goal, did not solve the problem. Thus, the appearance of a novel solution was shown to be the product of specific learning experiences—to physical, not mental, events.

This is just the beginning of generativity theory, however. Epstein describes other experiments along the same line and goes on to suggest that novel behavior, including the appearance of insightful solutions, may be predicted by a few "transformational functions." When entered into a computer, these equations yield a "probability profile" that identifies the relative likelihood of various acts, including the solution to a problem, at any point in time. The sudden appearance

of a novel solution, Epstein argues, is accounted for largely in terms of environmental history and a few well-established phenomena, in particular reinforcement, extinction, resurgence, and automatic chaining.

This work does not entirely explain the appearance of new behavior, of course, but it goes a long way toward moving the locus of the explanation from an intrinsically mysterious mind to the knowable physical world. In the process, it moves insightful learning, and novel behavior in general, from the philosophy of mind to the science of behavior. Bertrand Russell's challenge has been met.

It is possible, of course, that I give Epstein too much credit. Many researchers, including, in addition to those mentioned earlier, Duncker (1945), Eisenberger (Eisenberger & Selbst, 1994), Maltzman (1960), and Pryor (Pryor, Haag, & O'Reilly, 1969), have made important contributions to the understanding of original behavior. Even Skinner, who institutionalized the study of rate change, contributed to the field in important ways. But Epstein has made a leap that I believe carries behavior science to a new level. If I am right about this, then certain chapters in this book are essential reading for anyone worthy of the name behaviorist.

There is, unfortunately, much in the book that is not essential reading. In addition to about a dozen articles related to generativity theory, Epstein offers another two dozen on a variety of less important topics. These include essays in support of the term *praxics* as a name for behavior science; an adulatory poem directed at Skinner; and even two humorous bits of fluff reprinted from *The Worm Runner's Digest* and *The Journal of Irreproducible Results*. I have no particular complaint against any of the articles in the collection, but the mixture turns the book into a hodgepodge of miscellaneous papers and detracts attention from the generativity work. It is rather like having an art exhibit that includes some fine oils by Claude Monet alongside paintings of circus clowns by Red Skelton. We may like Skelton's clowns well enough, but what are they doing in the same room with Monet? Epstein's generativity work is of such importance that he should have created an anthology focused entirely on that topic. I urge him to do so in the near future, preferably in the form of a pocket-size paperback that is likely to reach students. In the meantime, we are stuck with *Cognition, Creativity, and Behavior*.

It could be worse. Although the book includes many articles that are destined to be forgotten, it does include some of the most stimulating reading in the field of behavior science. Before you pick it up, make sure you have a good point on your pencil.

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